

SCIENCE.

FRIDAY, AUGUST 28, 1885.

BIOGRAPHICAL SKETCH OF THE PRESIDENT OF THE ASSOCIATION.

PROFESSOR HUBERT ANSON NEWTON, who is the president of the American association for the advancement of science, has held the chair of mathematics in Yale College since 1856. Virtually, he has had charge of the instructions in that branch of science at New Haven since 1853, when the college was deprived, by death, of the services of Professor Stanley. He had evinced, in his undergraduate course, strong proclivities toward mathematical studies; and his appointment to a tutorship, two years after his graduation in the class of 1850, undoubtedly confirmed these predilections, and opened to him the career in which he has won distinction at home and abroad.

His outward life has been uneventful. From the time when he entered college, almost forty years ago, he has remained in New Haven, assiduously devoted to the work of his professorship. Occasional visits to Europe have brought him into personal relations with the mathematicians and the institutions of other countries. Academic honors, as little sought as they were well deserved, have fallen upon

him. He was made an associate editor, many years ago, of the *American journal of science*, in whose pages his principal memoirs have appeared; he has been a vice-president in the scientific association of which he is now the head; he was one of the original members of the National academy of sciences. In the Winchester observatory of Yale college, he is a leading manager. The University of Michigan conferred upon him, in 1868, the degree of doctor of laws.

But he has still stronger claims than these to that recognition which his scientific friends have bestowed by inviting him to preside over their meeting at Ann Arbor. It is as an astronomer that he has won his highest reputation; and, as an astronomer, his name is forever to be associated with the discovery and enunciation of the laws of meteoric showers, so mysterious when

he applied his mind to their investigation, so comprehensible now

Professor Newton came into the field of meteors by what might be called an official inheritance. While he was an undergraduate, Denison Olmsted, his teacher in astronomy, with Alexander C. Twining, Edward C. Herrick, and others whom they had enlisted, were intent upon understanding the phenomena of shooting-stars. The resplendent shower of



Nov. 13, 1833, had aroused the imagination and the determination of these keen observers, and they were constantly engaged in meteoric discussions. The enormous Texan aerolite, preserved in the college cabinet, was an imperishable wonder. The Weston meteor had been described, long before, by Silliman and Kingsley. Even in the previous century, Thomas Clap, the rector of the college, had published a tract upon meteors, interesting now as an embodiment of what was then known and thought. These were precursors of the investigations in which Newton was destined to become a leader. The story of this period may easily be gathered from an article (which appeared in the *New Englander* for 1868) by a writer qualified in all respects to prepare the narrative, Prof. C. S. Lyman.

Without going over the ground there traversed, we shall follow Professor Lyman in saying that the cosmical origin of the November meteors, and the true explanation of the radiant, as well as of its position with respect to the earth's orbit, had been well settled by the observations of Olmsted and Twining after the shower of 1833. Olmsted had attempted, but unsuccessfully, to point out the probable orbit of the meteors in space. Newton first took sure and definite steps toward such a determination. He collected and analyzed previous observations, and pointed out not only the five possible orbits, but how the only true one could be determined. The laborious computations necessary were made by the distinguished English astronomer, Professor Adams of Cambridge; and thus the orbit of thirty-three and one-fourth years was definitely established. Newton's papers on this subject in the *American journal of science* have become classical, and are referred to by all writers on meteoric astronomy. His later papers on comets are characterized by the same originality and ability as those on meteors, and have largely added to his scientific reputation. An important memoir from his pen appeared in the first quarto volume published by the National academy of sciences in 1866, wherein he endeavored to show the laws which govern

the movement of sporadic meteors, as he had previously investigated the phenomena of periodic showers. Two admirable summaries of what is known in respect to meteoric laws have been contributed by this acknowledged authority to the new edition of the *Encyclopaedia Britannica* (vol. xvi. 1883), and to *Johnston's Cyclopaedia* (1877).

In all matters pertaining to the advancement of education and the progress of science, Professor Newton has been a wise and firm upholder of conservative ideas. He has shown no desire for popular applause: he has rarely appeared as a speaker before public assemblies. But wherever he has been called upon, he has come forward with independence, courage, and persistence, to uphold what he believed to be right. In electing him to be their president, the association has shown its desire to honor one whose titles to such a distinction are of the most solid character, — important contributions to knowledge, by difficult and prolonged study, guided by an acute and well-trained mind.

LETTERS TO THE EDITOR.

**.* Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Man's ancestry.

PERMIT me to dissent from your editorial comment (*Science*, vol. vi., p. 81), that man is of those forms whose ancestry is unknown. I cannot but think that the data at hand are already abundant for an answer, and that we can allocate his systematic relationships as well as those of any other animal. The data are given in the anatomical monographs, or, better still, can be tested by a comparison of the structure of man, and the primates, as expressed in the skeletal and other systems. It is difficult for me to understand how any one acquainted with the data could reach a conclusion other than that man is the derivative of a form very much like the chimpanzee and gorilla, and that, could his remote ancestors be seen, they would be placed not only in the same family, but in the same group with the African apes. The general agreement in the skeleton, the anapophyses, the digits, the sternum, the pelvis, the carpal and tarsal bones, the tuberculation and ridges of the molars, and numerous other points in which there is similarity between man and the African anthropoids, appear to me to preclude any other scientific conception. Compare man and the anthropopithecus of Africa, contrast the several species with the other apes, and the monkeys generally, and then apply the doctrine of probabilities to the morphological results. The only logical conclusion must be that man is

descendant of an ape, which would be only generically separable from the chimpanzee and the gorilla; and that while the last two are little modified descendants from a common stock, man's structure, in some respects, has been much modified, — but even man's deviation is mostly superficial and psychological.

THEO. GILL.

Washington, Aug. 5.

[We meant, by the statement which Dr. Gill criticises, that the immediate exact ancestors of man are not known to paleontologists; and that the morphological evidence has not yet been so fully worked over as to afford definite conclusions as to the evolution of man. The elucidation of the exact affinities of man with various primates still awaits exhaustive study: that he is related to the anthropoid apes, is, of course, well established; but that he is more closely related to them than to any other primates has still to be proven. In suggesting a relationship between man and the monkeys, we meant rather to propound a question, than to advocate a conclusion. In reality, there is probably no essential difference between Dr. Gill's opinion, and the suggestion emitted in our comment, which our critic seems not to have understood as we intended. — ED.]

A mad stone.

Your question, Mr. Editor, having regard to Mr. Sampson's letter concerning a 'mad stone,' 'how did such a superstition arise?' admits of a ready answer. Many a porous stone, in good capillary condition, can *suck a wound*, not so effectively, perhaps, as the lips of Queen Eleanor, but still with considerable power. This fact is especially true in case the stone has been moistened so that close contact between it and the body may be secured, as well as continuity of the fluids, and evaporation from the external surface of the stone, to actuate the capillary flow. Familiar applications of the principle are seen when the country-boy puts a dab of mud upon the spot where a hornet has stung him to compose the pain; and when the housewife uses French chalk, or soap-stone dust, or wet plaster-of-Paris, or, better yet, clay moistened with naphtha, ether, or oil of turpentine to draw out a grease-spot from clothing or from the floor. Thus much for the basis of the 'superstition.' It is assuredly easy to conceive withal that 'mad stones' may have existed of such chemical composition, or charged with such chemical substances, that they could act as germicides as well as absorbents. Indeed, we have already in that most sovereign of balms, powdered chalk for a mosquito bite, something so nearly akin to the ideal mad stone, that your correspondent was more than justified in according to the matter his portion of that careful attention which Arago did extol.

F. H. STORER.

THE KONGO FREE STATE.

MR. STANLEY has given a history of the planting of this state, its growth to the present time, and the recognition of its flag and sovereignty by the powers of Europe and America, at the Berlin conference. His book has been supplemented by reports from French and Portuguese travellers; from Lieut. Cameron of the English army, who crossed Africa

from the east to the west a little below the valley of the Kongo; from Mr. W. H. Tisdell, the agent sent by our government to the Kongo; and from Admiral English, commander of our fleet on the African coast. These reports, though somewhat conflicting, can be reconciled, and the truth ascertained.

The Kongo free state, by the terms of the Berlin convention, controls a narrow strip on the northern banks of the Lower Kongo, from the ocean to Stanley Pool; thence the territory extends north-east to between the fifth and sixth degrees of north latitude, and south below the eleventh degree of south latitude, and east to within a few hundred miles of the Indian Ocean, including in its limits nearly all the water-shed of the Kongo and its branches.

The river is navigable from the ocean to Vivi. Between Stanley Pool and Vivi, 235 miles, there is a fall of 1,200 feet, with 80 miles of navigable water between the falls. There are a large number of navigable branches running into the Kongo, and steam-launches have sailed on the Kongo and these branches nearly 1,500 miles. Mr. Stanley estimates, indeed, that there are over 5,000 miles of uninterrupted navigation on them; and that, in addition, the navigable waters of other tributaries would probably bring the total to about 20,000 miles: these estimates cannot be fully relied upon, but there is sufficient evidence to prove that the navigable waters of the Kongo exceed those of any other river in the world.

The land in the eastern part of the water-shed of the Kongo is between 4,000 and 5,000 feet in height, falling at first pretty rapidly, and then more gradually, into the great valley of the Kongo, about 1,500 feet above the sea-level.

As the river rises in the east, runs to the west near the Equator, its valley has nearly the same climate, growing more temperate towards the sources of the river. The whole area is abundantly supplied with rainfall.

The outlets for the trade of this vast region have hitherto been south through the Portuguese territory to the Atlantic Ocean at Benguela, or else north-west through the French possessions to the valley of the Ogowé. The Kongo offers the shortest route to the ocean, but the river has cut its way through the chains of mountains; while the Kwilu Niadi, in the territory of the association, and the Ogowé, follow natural valleys, and reach the ocean by longer and easier routes.

Mr. Stanley constructed a road around these falls. It crosses a succession of valleys and steep hills, some one thousand feet in height.

In the valleys are streams, lowlands, and swamps; and the lowland is so rich, and the growth so luxuriant, that the grass and cane attain a height of from eight to ten feet in a short time, and completely hide and obstruct the road, so that it is almost impossible to maintain it in a passable condition. As there are no beasts of burden in the country, all goods are carried around the falls on the heads of porters, or pulled up the steep hills.

A small steamer, the *Stanley*, of thirty tons burden, constructed in sections, arrived at Vivi nearly two years ago. A force was at once organized to move these sections to Stanley Pool; but all efforts have been fruitless, and the different sections now lie rusting in the valleys or on the hills.

Two hundred and fifty thousand dollars are annually paid for porters between Stanley Pool and the coast, by the International association, native traders, and three missions.

The expense of transporting merchandise and stores from the ocean to Stanley Pool, exchanging them for the products of equatorial Africa, and carrying these to the ocean, exceeds the value of the articles when delivered at the stations on the coast. Mr. Stanley admits this fact, and says that "the Kongo Basin is not worth a two-shilling piece in its present state."

The only way in which the products of equatorial Africa can be conveyed from the Kongo to the ocean, is by means of a railroad constructed either down the Kwilu, the Ogowé, or the Kongo. The Kongo railroad will probably cost much more per mile than one by either of the other routes; but, as it is the shortest, the total expense of construction will be less, while the operating expenses will be much less.

Whenever the merchants and bankers of Europe and America are convinced that this road will pay, it will be built, and the settlement and civilization of Africa commenced.

Little difficulty has been found in procuring laborers for the construction of the Panama railroad and canal, and no greater difficulty will be found in the construction of this road.

It therefore becomes necessary to ascertain if the soil is fertile, and yields bountifully the products that are required in temperate regions, and if the climate permits cultivation and trade to be carried on under the supervision of white men.

The steamers of the association have visited many tribes on the banks of the Kongo, establishing stations, and examining the bottom lands of the Kongo and its branches. But

they know little of the great valley of the Kongo and its tributaries. It is believed that the soil is generally fertile, though there are probably, both north and south of the river, large lakes and tracts of low and swampy land. But a long time must elapse before equatorial Africa is thoroughly known.

The soil in the valleys is exceedingly rich, and yields all the products of equatorial countries. Cattle are not found; but, as they are raised in large quantities on the eastern part of the water-shed, they can probably be raised in the valley. Ivory, palm-oil, rubber, dye-stuffs, and gums are abundant; and tea, coffee, cotton, pepper, spices, and sugar can be grown to an almost illimitable extent.

A rich and fertile soil is of little value without laborers to till it. These cannot be brought from abroad, but must be found in the country itself. The natives of Africa are naturally improvident, and work only when compelled by the whip of the master, or necessity. They have few wants, require little clothing, the ground yields spontaneously enough for their support, the rivers abound in fish, and the women do all the work.

The early laborers employed by Mr. Stanley were Kurmen from the west coast and Zanzibaris from the east coast; but Mr. Stanley has gradually substituted native labor, and now fifteen hundred natives are on the pay-roll of the association. As the negro is taught the wants of civilized life, he will, by slow degrees, be induced to work; but a long time must elapse before the lands of equatorial Africa are settled and cultivated to any great extent.

It will be impossible to carry on trade with Africa, or civilize the country, without the presence of white men.

The western coast of Africa is the most unhealthy country in the world; and the loss of life at the stations at the mouth of the Kongo, and in the expedition of Capt. Tuckey, seemed to prove that the valley of the Kongo was equally unhealthy. Reports from returned employees of the association, and others, confirm this opinion. They say that a large number of the foreign employees have died, while many others, enfeebled by disease, have returned home.

It is evident, from the account of Mr. Stanley, that there has been a large proportion of deaths and disabilities among the employees of the association; that exposure or intemperance, which in Europe causes only temporary inconvenience, is followed on the Kongo by fever, and often by death, in a very short time. The statistics are insufficient to enable

us to form a correct judgment in regard to the mortality.

Mr. Stanley was unfortunate in the selection of several of the stations, particularly those at Vivi and Stanley Pool. They were located on high ground, and supposed to be peculiarly healthy; but at these stations the hills on the two sides of the river converge, and the cool breezes from the river and the valley blow over the stations as through the mouth of a funnel: and sickness and death are much more frequent than in low stations in the valley of the river protected from the wind by the hills or trees.

Mr. Stanley asserts, and we think he is correct, that when the sanitary conditions are better understood, and the exposures incident to the settlement of a new country overcome, proper food obtained, with temperance in eating and drinking, a man can accomplish as much work in equatorial Africa as in temperate Europe; provided, as stated on another page of *Science*, he returns home every eighteen months for a vacation of three or four months.

The death-rate is always high in new countries. In New England, and in the temperate regions of America, as well as in torrid zones, new settlements are always unhealthy, and great mortality prevails; and not until permanent settlements are made can we pronounce upon the healthiness of any climate. We believe that equatorial Africa, being nearly two thousand feet above the level of the sea, will be less unhealthy than India, or many other countries where white men live, and carry on a large and successful trade.

The association has already planted twenty-two stations up and down the valley of the Kongo, and expect to plant and maintain other stations every fifty or one hundred miles on these waters. The natives within the influence of these settlements are beginning to labor, and bring in their productions to the settlements. A small amount from each station will make a large foreign export, sufficient to support a railroad from Stanley Pool to the ocean.

The stations are now ready, but the merchants cannot successfully establish stores for trading with the natives until the railroad is built. The cost of the railroad is estimated by Mr. Stanley at \$5,000,000 in the body of his book, and at \$7,500,000 in the appendix.

All that equatorial Africa now requires, is the construction of the railroad from Stanley Pool to Vivi; and we trust and believe that the same good judgment, executive ability,

and energy, which have won success for Mr. Stanley's other undertakings, will enable him to raise the funds for this enterprise, open the heart of Africa, and accomplish the objects of the association. GARDINER G. HUBBARD.

COMPOSITE PORTRAITURE.

THE process of composite photography has been applied to the solution of two problems: 1. Given a series of objects having in common an interesting characteristic, to find a single type which shall represent the whole group. 2. Given a series of representations of the same object, to find a single representation which shall give a superior effect by combining the strong points, and neglecting the defects, of each of the series. The latter problem is by far the simpler. The composite of six medallion heads of Alexander the Great may be taken to represent the real Alexander better than any one of the originals, because the probability of the six artists having introduced the same inaccuracy is very small. In the first problem, however, we are introducing an essentially new face, — a type representing *par excellence* the peculiar characteristic for which the originals were grouped together. In combining the portraits of criminals, the object is to get a type of criminality; in combining the portraits of national academicians, one of recognized scientific ability.

Other methods of producing a type are when the artist puts on paper the general effect of more or less unconscious observation of physical peculiarities in the class of persons represented; or when the anthropologist selects among a number of savages, for instance, one who was judged to have all the distinctive marks of his tribe in neither an exaggerated nor a deficient degree, and yet combined with them no individual eccentricities, — in short, that much-talked-of average man, whom one does not meet every day. Composite photography aims to take this process out of the hands of erring judgment and vague imagination, and reduce the art of type-getting to a mechanical one of combining photographs.

In several cases, when various images have been combined to elicit a type, it has happened that the resultant has been remarkably similar to one individual of the group represented. This was strikingly illustrated in the portraits published in *Science*, No. 118. Mr. Galton mentions, that in one such case he took a second composite, omitting the face which resembled the first composite, and the two pictures thus

obtained were practically alike. In the case of the national academicians, the gentleman referred to as representing the type was not one of the sitters at all. The explanation of this peculiarity (excluding all possibility of mechanical error in photographing) seems to be possible in two ways. It may be regarded as an example of what has been spoken of as 'prepotency,' which means that one set of features was so powerful and characteristic as to outweigh the effect of all others not in harmony with it. On the other hand, it may be said that the peculiar face is really very nearly the arithmetical mean in point of appearance of its class. For example, if we desired the average height of twenty-one men, five of whom were five feet ten inches high; five, five feet nine inches high; one, five feet eight inches; five, five feet seven inches, and five, five feet six inches, each, we might take the man of five feet eight inches as the average of the lot. This individual would then be the mean of his class, just as the one face was the mean of its class. If, now, we omit the man of just five feet eight inches in height, the average of the group is not altered in the least. So, also, in omitting the one photograph, as Mr. Galton observes, the type is not altered. This leads probably to the latter explanation.

The problem is reduced to its simplest terms in the combination of but two faces. The resultant here ought to be the exact mean between the two originals. If the composite resembles one more than the other, we must regard that one as the more powerful characteristic face; if it resembles each of the originals, they probably resemble each other; if it differs from both, they differ from each other. That is, the mean of three inches and five inches does not differ much from either, nor do they differ much from each other: the mean of one inch and seven inches is also four inches, but the differences between them and the mean are large.

I have attempted to experiment with ordinary photographs, and without the elaborate apparatus of composite photography, and give my results, in the hope of thus placing the process within the reach of every one.

The most natural method of combining two pictures is by means of the well-known Brewster stereoscope. I tried this, and was surprised at the splendid result. I went to work with all the fervor of an original discoverer, but afterwards found, on looking at Mr. Galton's article, that he had done the same. I mention this, because Mr. Galton himself, in the same place,¹ admits

an independent suggestion, both of this and of composite photography, in the shape of a letter from Mr. Austin of New Zealand, to Charles Darwin.

It was easy to arrange a device by which one of the two photographs could be raised or lowered, moved laterally, and also swung around its centre so as to bring its image exactly in correspondence with that of the other photograph. The only requisites are that the two pictures be approximately of the same size and position. When these requisites were not satisfied, I found other methods of combining them, as will appear below. With an ordinary stereoscope and a family album, any one has the means of an amusing and instructive study. A few of the results gotten in this way may be worth recording.

As was said before, in uniting two pictures, say of two sisters that are commonly considered to resemble each other, the composite is very much like either. Some will call it more like the one, some more like the other. By alternately closing each eye, and then opening both, the observation becomes more striking. If the pictures represent persons who are total strangers to each other, the result is often an entirely different face from either. The effect is peculiar of combining the photographs of two persons of opposite sex. The male face seems to predominate; but this is probably due to the influence of the beard, mustache, etc.; for in combining children of opposite sex, or using photographs of adults with smooth faces, the predominance disappears. Like the beard, so, too, the hair, costume, etc., are apt to lend an undesirable peculiarity to the composite. This can be partly avoided by cutting out the shape of the face proper in white paper, and attaching it with a rubber band to the photograph, thus combining the features alone. On the same principle, one can combine the upper part of one face with the lower part of another by covering with paper the suitable parts of each.

One can combine persons of different ages with good result. A young lady of twenty, combined with her mother of sixty, gives a lady of about forty years of age. A still more striking case is, when a girl and her grandmother give as a composite a middle-aged woman much more like her mother than like the girl herself, or her grandmother, although a family resemblance runs through the group.

As Mr. Galton says, the effect is often to idealize the faces. A composite of two photographs of the same person gives a composite far better than any photograph actually taken

¹ Inquiries into human faculty.

of the individual. The combination of a photograph of a person at one age, with that of the same person at a different age, is very much like what the person looked at an intermediate age. The effect of hair, costume, etc., often spoils the result.¹

While the combination with an ordinary stereoscope is very satisfactory, there are a few advantages in using the original form of the instrument as it was invented by Wheatstone. This consists of two mirrors set at right angles, and two bars running out perpendicularly to the faces of the mirror. Along these bars uprights, holding the photographs, can be moved. One eye looks into each mirror, and the combination of the two images takes place. Differences in size of the photographs can be accounted for by moving the larger one farther off, and the smaller one nearer. As soon as the two images, as seen side by side, are of the same size and position, the bars are moved on their common axis until the images coalesce. The composite thus formed is even better than the Brewster stereoscope, and the arrangement lends itself to a greater variation in the experiment. Two cautions may be useful: 1°. The head must not be moved. A prong of wood attached to the instrument, and held between the teeth, will be an aid. 2°. The illumination of the two pictures must be alike, or else the more strongly illuminated will give the character to the composite.

While composite photography has always made use of photographs, there is no impossibility in making a composite directly from the original sitters. A Philadelphia photographer has been successful in producing a composite of two sisters from actual life. The method is, doubtless, more troublesome than the usual one. With the Wheatstone stereoscope, one can combine living faces by having two persons assume appropriate positions; and, as before, by guiding the movements of their

heads, uniting the images in the mirrors. Both the full face and the profile give a peculiar and lifelike effect.

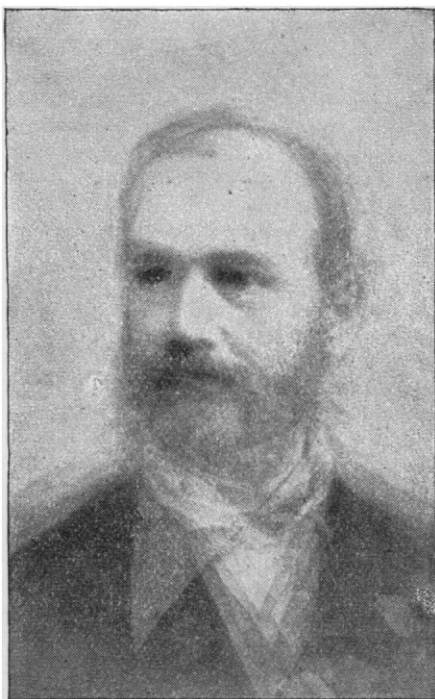
The most common difference in the position of photographs, as ordinarily taken, is the direction of the head; i.e., whether more of the left or the right side of the face is shown. Two photographs, looking in opposite directions, cannot be combined by any of the above methods. A simple device overcomes the difficulty. A piece of mirror is held directly in front of the face between the two eyes. The two pictures are set side by side; one is looked at directly with one eye, while the other is seen reflected, and, of course, reversed in the mirror. By moving the photograph until its reflection coincides with the other, a perfect blending takes place.

I have tried combination by means of the zœtrope. Simple figures can be satisfactorily combined; but so complicated a design as the human face, is accompanied by a vagueness of outline and detail which render the process useless. By using five or six of each of the two photographs to be combined a distinct face is seen. Even then the result is not nearly so good as in the stereoscopic combination. Besides, there is no way of accounting for small differences in the photographs. In combining several pictures, one gets nothing but a jumble of faces.

The fatal objection to all these hand-processes is, that but two photographs can be combined at once. To unite the resultant composite of two or more stereoscopes, is, perhaps, possible, but would certainly prove very troublesome. An apparatus, that, by a system of mirrors, would superimpose a series of images, suggests one method of extending the processes above described. JOSEPH JASTROW.

A COMPOSITE PORTRAIT OF THE OFFICERS OF THE ASSOCIATION.

The accompanying photo-engraving is a composite of the photographs of the higher officers present at last year's meeting of the



¹ I would suggest that this method offers a means of studying the nature of the expression of the emotions.

American association for the advancement of science: these were, Messrs. Newton, Lesley, Newcomb, Asa Gray, Cope, Hilgard, Putnam, James Hall, J. W. Langley, Morse, Eaton, N. H. Winchell, Wormley, Thurston, Eddy, Springer, and John Trowbridge.

It was prepared by Mr. W. Curtis Taylor of Philadelphia,¹ who had never seen a composite before preparing it; and it is therefore less successful than might otherwise be expected. As in the previous composites published by us, it makes a younger and handsomer man than the average of those whose faces enter into it. The average age of these seventeen gentlemen can hardly be less than fifty.

THE YACHT PURITAN.

THE yacht Puritan, which has just raced so successfully with the New-York sloop Priscilla, was designed by Mr. Edward Burgess of Boston with a view to combine the speed of the ordinary type of American sloop with the weatherliness of the English cutter. The race for the Goelet cup at Newport, Aug. 3, seems to show that we have, at last, a successful compromise. Puritan measures 93 feet on deck from the fore side of stern to the aft side of her long and slender taffrail. Extreme beam, 22 feet 7 inches. Draught, 8 feet 4 inches. Displacement, 105 gross tons. The lead keel weighs 25 tons; and 20 tons of lead are stowed inside, four or five tons of which are run into the garboards. The centre-board is 21 feet long and 10 feet deep. The spar measurements are: mainmast, 78 feet; topmast, 44 feet; boom, 76 feet; gaff, 47 feet; bowsprit, 38 feet (outboard). Lower-sail area, 5,500 square feet.

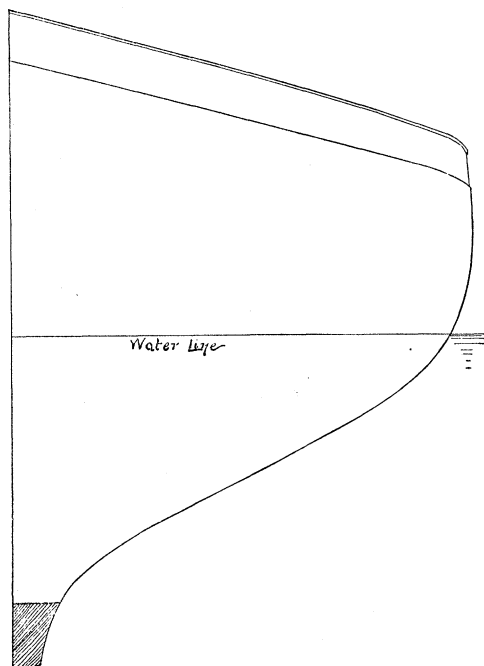
Many yachting critics predicted that Puritan would not carry her sail; that her lead keel, combined with so much beam, would make her very uneasy in a seaway; and that, like other compromises, she would be slow. Her record so far has, however, been entirely satisfactory. In the Newport race, while the fastest cutter yet built in America — Bedouin — plunged into every sea, finally losing her bowsprit, Puritan never put her bowsprit under, and beat the cutter *one hour* in the twenty-mile thrash to windward.

Puritan's rival, Priscilla, is undoubtedly a very fast craft; and with her rig reduced, she may yet prove a troublesome antagonist, with her five feet extra length.

The success of both boats, which a new

book on the America's cup calls 'experiments,' points to a brave defence of the cup, and holds out good hope that it may still remain on this side of the Atlantic.

The midship section of Puritan, given herewith, is published for the first time. Her longitudinal section shows a rather deep forefoot with a rocker keel and raking stern-post. Both fore and after bodies are unusually fine.



The load water-line shows about five inches hollow.

The picture, showing Puritan under lower-sails and club-gaff topsail, is reproduced from a photograph taken by N. L. Stebbins in the Eastern yacht race, June 30, when she beat the next boat in her class nearly half an hour over a short course.

THE PRESIDENT'S ADDRESS.¹

MY FRIENDS: I have the honor to address you this evening as an association of representatives of American science in all its branches, — as students of the sky and all its elemental forces, of the earth and all its mineral constituents, of the animal and vegetable kingdoms in their past and present ages, of the history and constitution of the human race, — and I may be easily pardoned for some trepidation in view of the draughts you may have drawn in advance on my

¹ We are indebted to the courtesy of this gentleman for the opportunity of reproducing it.

¹ Address to the American association for the advancement of science at Ann Arbor, Aug. 26, 1885, by Prof. J. P. LESLEY of Philadelphia, the retiring president of the association.

slender exchequer. I have lain awake o' nights, like my predecessors, reflecting how I should meet my liabilities. And like them, no doubt, I find myself poorer than when, a year ago, I contracted them. You would scorn to receive in payment my promissory notes or mortgages on my castles in Spain. You will accept nothing but gold and silver, in bullion or in coin; and that is what troubles me.

There were once halcyon days for orators: the world of knowledge limited, and canopied with rosy clouds of curious speculation; the birds of fancy singing in every bush; the dew of novelty glittering on the fields. Science was then an early morning stroll with sympathetic friends, uncritical and inexperienced, to whom suggestions were as good as gospel truths. Then, such a reunion as this to-night was a sort of picnic-party, at some picturesque place on the shore of the unknown, hilarious and convivial.

All that has passed away. The sun of science now rides high in heaven, and floods the earth with hot and dusty light. What was once play has turned to seri-

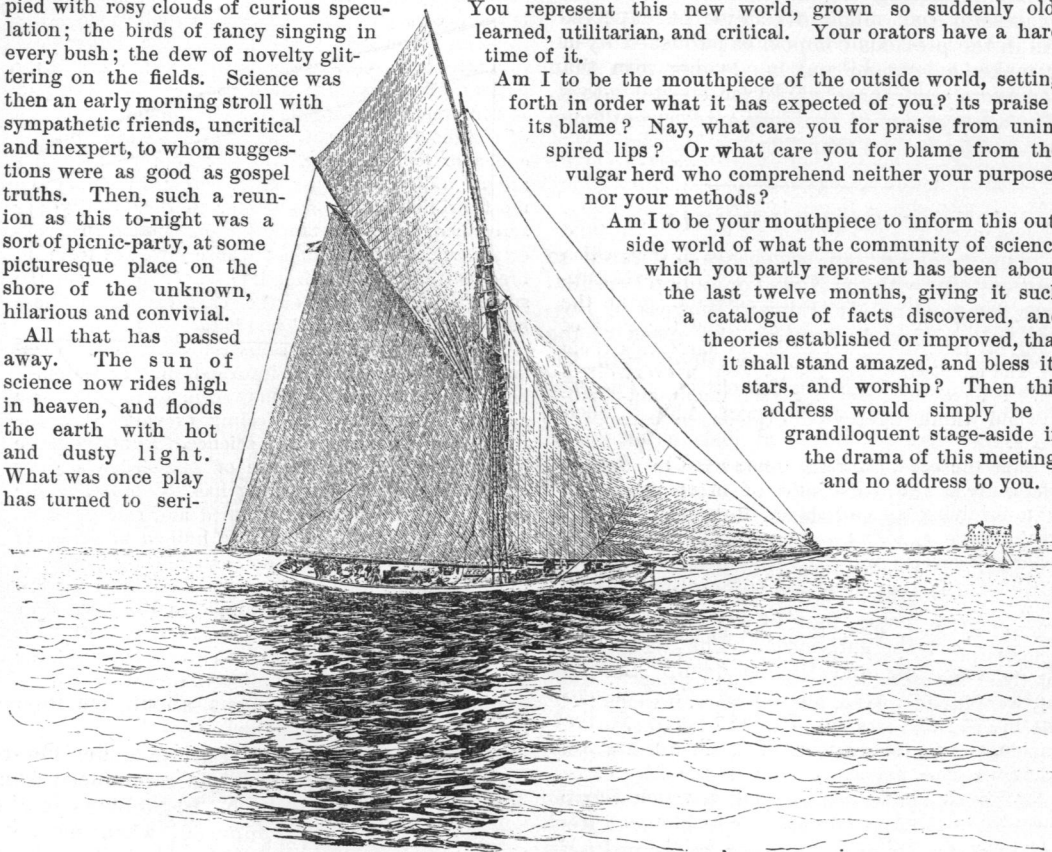
ous toil. Shadows are short. Objects present themselves in well-defined and separated shapes for critical examination. The few and early risers have become a multitude. The tumult of occupations distracts the studious observer. No one lends ear to chit-chat. All are hurried. Critics abound. "Say what you want, and go; or tell us something absolutely true and useful," is the introduction to every conversation. Morning, noon, and night, men demand, not the agreeable, but the necessary. The age of romance in science is part of the forgotten past. The new world has grown gray-haired in fifty years, intolerant of the irresponsibility, the sportiveness, the poetry, the music, the superstitions, the affections, of its youth; dealing only in hard facts,

and in their causes and consequences; weighing and measuring all things; analyzing all things; collating, comparing, and classifying; insisting upon investigation at all points; formulating rigid laws; scoffing at the unseen and unknowable; and transmuting the fear of God and the hopes of heaven into a zeal for the exact determination of the units of force, and a confident expectation that railroads will soon traverse all the unoccupied regions of the earth, and malleable steel replace wood in the mechanic arts.

You represent this new world, grown so suddenly old, learned, utilitarian, and critical. Your orators have a hard time of it.

Am I to be the mouthpiece of the outside world, setting forth in order what it has expected of you? its praise? its blame? Nay, what care you for praise from uninspired lips? Or what care you for blame from the vulgar herd who comprehend neither your purposes nor your methods?

Am I to be your mouthpiece to inform this outside world of what the community of science which you partly represent has been about the last twelve months, giving it such a catalogue of facts discovered, and theories established or improved, that it shall stand amazed, and bless its stars, and worship? Then this address would simply be a grandiloquent stage-aside in the drama of this meeting, and no address to you.



THE YACHT PURITAN, AFTER A PHOTOGRAPH BY STEBBINS.

ous toil. Shadows are short. Objects present themselves in well-defined and separated shapes for critical examination. The few and early risers have become a multitude. The tumult of occupations distracts the studious observer. No one lends ear to chit-chat. All are hurried. Critics abound. "Say what you want, and go; or tell us something absolutely true and useful," is the introduction to every conversation. Morning, noon, and night, men demand, not the agreeable, but the necessary. The age of romance in science is part of the forgotten past. The new world has grown gray-haired in fifty years, intolerant of the irresponsibility, the sportiveness, the poetry, the music, the superstitions, the affections, of its youth; dealing only in hard facts,

Must I, then, speak to you as a fellow-worker in science, contributing some fresh gift to our common stock of truths? But that would be better done, if done at all, by reading a paper on the subject in the section to which I properly belong.

I did, indeed, hesitate a while before I rejected a temptation to discuss before you this evening one or two subjects on which I have reflected for many years,—for instance, the important rôle which the chemical solution of the limestone formations has played in the grand drama of the topography of the globe; the absolute inconstancy of the ocean-level; the function of variable deposition in closed basins in elevating the plane at which coal-vegetation repeated itself; the influence which anticlinals and

synclinals *en échelon* have exercised in originally directing, and afterwards perpetually shifting, the systems of river-drainage, as the general surface became lower and lower through erosion; the extraordinary differences in the amount and rate of erosion in different parts of the same region, due to the various heights and shapes of the plications,—but a deep sense of insufficiency for properly handling such great subjects deterred me from the attempt. They demand the largest treatment, the fullest illustration, and the long coöperation of many minds. All the great transcendental questions of science remain open to research; not one of them has as yet been answered satisfactorily; all answers have been premature, and most of what has been published for such seems to me puerile; yet the disposition to deal in transcendental science seems to grow daily stronger. There are no laws, however, against initiation into Alpine clubs. If men choose to run fatal risks for notoriety, let them do so, in the name of all that is chilly and unprofitable; but let them not pretend, that, when they reach the summit of some Jungfrau or Matterhorn, their demon of adventure shows them all the kingdoms of the world of science, and the glory of it; for, in fact, the inaccessible sky surrounds them still, and clouds obstruct their vision in every direction. I have no fancy for such mountain-climbing, and think lightly of exploits so barren of results.

I seize the occasion, rather, to awake to your remembrance some thoughts of common interest, which the multiplying avalanches of facts and theories threaten to bury out of sight, as the pure ice of the glacier gets covered over with a sordid sheet of *débris*, perpetually tumbling from the cliffs between which it flows.

Consider, then, first, that the final cause of a glacier is not to carry moraines, lateral or medial; that these are mere accidents of its existence; and that, were it endowed with intelligence, it would feel little interest and less pride in the heterogeneous, variable, and for the most part useless, burden, which it cannot escape, and throws away at the close of its career. Such are the loads of science which we are compelled to carry forward through life, in the forms of fact and theory; misshapen, accidental droppings upon us from our local surroundings; fragmentary specimens of knowledge, of which we construct our confused and shapeless heaps of learning, most of which is of little use, either to ourselves or to the world. The life of the glacier is an elaboration of the universal moisture into snow, névé, and pure ice, by a slow process of internal constitution; and such is the happy destiny of the true man of science, worked out in wisdom of character, apart from all accidental accumulations of learning, and mainly irrespective of them.

Let us avoid the sacrifice of character to science. As the saying of Jesus of Nazareth, that the sabbath was made for man, not man for the sabbath, has rung through the centuries, a tocsin of alarm to rouse mankind to resist ecclesiasticism, so let the warning cry fill the air of our association, from meet-

ing to meeting, that science is our means, and not our end. Self-culture is the only real and noble aim of life. And as the magnificence, beauty, and utility of a glacier, as a perpetual reservoir of solid moisture, is not gauged by the size, arrangement, or constitutional features of its moraines, neither is the greatness and usefulness of the philosopher measured by his amount of the knowledge of the physical fact-and-theory science of the times.

Of all kinds of intellectual greatness, the greatest is achieved by the philosopher who stands before the thinking world as a model of scientific virtue; deaf to flattery; insensible to paltry, hostile criticism; patient of opposition; dead to the temptations of self-interest; calmly superior to the misjudgments of the short-sighted; whom nothing diverts from the endeavor to live nobly, and to whom noble means are as indispensable as noble ends; in whom the most brilliant successes foster neither vanity nor arrogance; to whom fame is unimportant, and poverty a trivial circumstance; whose joys, like fragrant breezes from an encircling landscape, come from the surrounding friendship of the general world, to whose best interests the noble heart is forever loyal.

Another subject for serious reflection is the over-accumulation of scientific information. To broach it before such an assembly may seem to require some apology. Certainly, the feeling prevails, that the world cannot have too much science. But the science of learning and the science of knowledge are not quite identical; and learning has too often, in the case of individuals, overwhelmed and smothered to death knowledge. The average human mind, when overstocked with information, acts like a general put in command of an army too large for him to handle. Many a vaulting scientific ambition has been thus disgraced. Nor is this the only danger that we run; for the accumulation of facts in the treasury of the human brain has a natural tendency to breed an intellectual avarice, a passion for the piling-up of masses of facts, old and new, regardless of their uses. In the great game of our spiritual existence, facts are mere counters with which to play the game. A million of them are worth nothing, unless the player knows how to play well the game; and when the game is over, the worthless counters are swept back into the drawer. And the danger pursues us to higher and higher planes of science. Not only the avarice of facts, but of their explanations also, may end in a wealthy poverty of intellect, for which there is no cure. Even the sacred fires of research may be allowed to burn too long, until, in fact, they turn the investigator into a mere miser of ideas. As for those who are not themselves original investigators, but busy themselves incessantly in appropriating the secretions of research at second hand, how often it happens that the richest additions of reliable theories to the stock of their ideas, even to a point where they suppose themselves, and are supposed by others, to know all the conclusions arrived at by past and present inquirers, leave them as thinkers just what they were at first,—incompetents; mere ill-hung picture-galleries; disarranged museums; complicated inventions

which will not work; costly expeditions for discovery, frozen fast and abandoned in the polar ice.

A certain temperance in science is obligatory from another point of view. As mere wealth of possessions cannot guarantee happiness, neither can a superfluity of learning insure wisdom. When the body from overfeeding grows plethoric its vital energies subside and its life is endangered. The intellect may be mischievously crammed with science. How much we know is not the best question, but how we got what we know, and what we can do with it; and, above all, what it has made of us. The tendency of training now is to subordinate the soul to that which should be merely its endowment and adornment; to turn the thinker into a mere walking encyclopedia, text-book, or circle of the mechanic arts; not to produce the highest type of man. What ridiculous and pitiable creations are these!—an authority in physics who cannot speak the truth? a leader in natural history who is given over to the torments of envy? a god in chemical research sick of some false quotation? a youthful prodigy of mathematical science tottering with unelastic steps and outstretched arms to grasp his future fame? Yet no one will deny that the intemperate pursuit of any branch of science has a tendency to produce such characters, by elevating to undue importance the individual accumulation of scientific facts and scientific theories, to the neglect and depreciation of that spirit of truth which alone can inspire and justify an earnest study of the material universe. I beg you to reflect that it is as true of science as of religion, that the mere letter of its code threatens its devotee with intellectual death, and that only by breathing its purest spirit can the man of science keep his better character alive,—that indefinable spirit which, in its intimate and essential nature, has little to do with the number of facts discovered, or theories accepted; a spirit which merely exercises itself in research, and accepts discoveries as delightful accidents; a spirit which walks the paths of science, not as if they were turnpikes converging upon some smoky and squalid focus of toil-wearied population, but as if they had been gravelled and flower-bordered for it through some princely park; a spirit of natural and cultivated nobleness, sweetened by boundless friendship for the world and all that lives therein; just and true to all men worthy or unworthy, proud without vanity, industrious without haste, stating its own griefs as lightly as an angel might, and generously bringing help to the discouraged and forlorn. In every one of us there is this genius, if we did but know it; and, as Emerson well says, the moral is the measure of its health.

I have been saying, then, that we should pursue science, like any other business of this life, with a distinct and unwavering intention to ennoble our own characters. It were a trite addition to propose that the pursuit be made ancillary to the public good. 'The love of science' is a phrase which has been greatly glorified in popular discourse; and if the phrase be confined to its true meaning,—a zealous admiration for all that is beautifully true and useful in nature,—it cannot harm us in the practice of our profession.

But when the imagination has exhausted itself in transcendental ecstasies over an ethereal sentiment so named, but undescribed except in poetry, what wiser or better thing can we say of any branch of physical or natural science, cultivated by our association, than that its votaries are knowingly or unknowingly bettering the condition and character of mankind? Every advancement in science is, of its own nature, an improvement of the commonwealth. Every successful study of the laws of the world we inhabit inevitably brings about a more intelligent and victorious conflict with the material evils of life, encouraging thoughtfulness, discouraging superstition, exposing the folly of vice, and putting the multitudes of human society on a fairer and friendlier footing with one another. The arts of philanthropy are, therefore, as direct an outcome of science as the lighting of the public streets, or the warming of our homes. Cruelty and shame are products of the night. The daylight is a friend to friendliness. The progress of civilization and the progress of science are alike typified by the progressively brilliant and general illumination of cities. So, in old times, human sacrifices and piracy ceased wherever the worship of the Tyrian Melcarth yielded place to the philosophy, belles-lettres, and fine arts of the genial and beautiful Delphic Apollo, the civilizer, the far shiner, the sun of Grecian righteousness, whose initiated became the educators of the modern world.

And yet these two magic words, 'initiation,' 'education,' have meanings directly the reverse of one another,—the one a *going in* to learn the secrets of esoteric doctrine, unsafe for publication because immature; the other a *being led out* from ignorance to knowledge, from helplessness to the active performances of life. The idea of universal education is wholly modern; in fact, a product of the century in which we live. It is democracy in the world of intellect. It is the doctrine of equal human rights applied to the possessions of the human brain. It is the apotheosis of common sense. It demands the distribution of knowledge in adequate quantity and quality to all who live and all who are to live upon the earth. How this is to be accomplished, is the greatest of the questions of the day; and it especially concerns us as members of an association for the advancement of science.

I do not intend to discuss the subject, to define the quantity and quality of knowledge adequate for the various classes of human society, or to propose any plans for its distribution. All I wish to say about it is, that it seems to me nature limits both the responsibilities of teachers and the rights of learners more narrowly than is commonly supposed. The parable of the sower is a good reference for explanation. Most of the surface of the globe is good for little else than cattle-ranches or sheep-farms; and the large majority of mankind must, in all ages, be satisfied with the mere rudiments of learning: what they want is unscholastic wisdom with which to fight the fight of life, and they must win it for themselves. Only a limited number of persons in any community can acquire wealth of knowledge; and the only thought

on which I wish to insist is this: these few must also get it for themselves, and, moreover, must work hard for it.

It is a hackneyed aphorism, that there is no royal road to knowledge, although an incredible amount of pains has been taken to make one. Nature, in this affair as usual, has been a good, wise mother to us all; for it is not desirable to make the acquisition of knowledge easy; for the main point in scientific education is to secure the highest activity of the human mind in the pursuit of truth; an activity tried and disciplined by hardship, and nourished on hardy fare. The quantity of food is of less importance; every thing depends on establishing a good constitutional digestion. The harder the dinner is to chew, the stronger grows the eater. Canned science, as a steady diet, is as unwholesome for the growing mind as canned fruits and vegetables for the growing body. The wise teacher imitates the method of nature, who has but one answer for all questions: "Find it out for yourself, and you will then know it better than if I were to tell you beforehand."

But who can be a wise teacher who has not been wisely taught? The spirit of this scientific age favors a universal manufacture of condensed milk to ease and cheapen the toil of bringing up its infants. It finds the bottle of literature more convenient than the breast of nature. It prefers a large family of puny children to a few young heroes. The stalwart ancients exposed their unfit offspring to the wolves; we moderns exhaust the resources of art to preserve their worthless and painful lives.

This is the spirit which invents a thousand futile plans for compacting the universe to a size so small, and a shape so simple, that it can be grasped without much effort by the tiniest and feeblest hands. Will it be an unpardonable crime for me to say that I recognize the same spirit in the present popular rage for an over-classification, unification, and simplification of science; for ultra-symmetrical formulæ, and excessive uniformity in nomenclature; with an avowed reference to ease of learning and convenience of teaching, the saving of time in the acquisition of facts, and the diminution of brain-waste in collating them for use; in one word, to the making of science easy, in despite of the inexorable decree of nature, that it always shall be and always ought to be difficult? For the genius of the creation is visibly hostile to that uniformity, symmetry, and orderly simplicity which the text-book endeavors to establish. No logical consistency for her! No stiffening of the fact-producing energies into fact formularies will she endure. Hardly has a manual issued from the press but it is mutilated by her puckish fingers. No sooner has some school of theorists erected a stately structure in simple grandeur, than it is shattered by the lightning of a new revelation. There is no rest, no peace, in our believing. Our libraries contain little else than such spoiled palimpsests; the broad fields of science are covered with such ruins; and those who have grown old in travelling far and wide across them would find little cause for singing paeans to the exploits of science were it not for the fact that the

function of science is not to organize nature, but by the laborious study of nature to organize the human mind, and inform it with the very genius of nature, original, unsymmetrical, indefinable, unclassifiable, changing its attitudes and operations every instant, and escaping easily from all the toils of scholastic unification which we spread for it. The work of the student cannot be simplified, cannot be made easy, if it is not to fail in its great purpose, the production of a genuine man of science. The foolish nurse thinks it her duty to carry the child always in her arms; but the test of a good education is the ability of the child to carry its nurse; and this it can only attain to through the discipline of toil; toil which at first conceals itself under the gracious guise of sports, gymnastics, and adventures, and afterwards takes the shape of experimental failures and useless constructions, but all as free, untutored, and original as the laughing, wasteful, and ungovernable pranks of nature. But I have followed long enough, perhaps you will think too long, this train of thought: let me suggest another.

It is a familiar fact, that great discoveries come at long intervals, brought by specially commissioned and highly endowed messengers; while a perpetual procession of humbler servants of nature arrive with gifts of lesser moment, but equally genuine, curious, and interesting novelties. The excitement of the pageant incapacitates us for reasoning rightly on its meaning. From what unknown land does all this wealth of information come? Who are these bearers of it? and who intrusted each with his particular burden, which he carries aloft as if it deserved exclusive admiration? Why do those who bring the best things walk so seriously and modestly along, as if they were in the performance of a sacred duty for which they scarcely esteem themselves worthy; while those who have little to show, or things of inferior or doubtful value, strut and grimace magnificently, as if they felt themselves the especial favorites of nature, push to the front, speak loudly to the multitude, and evidently deem themselves entitled to uncommon honors?

In this procession of science, in this interminable show of discovery, two facts arrest attention: first, the eager gaze of expectation which the crowd of lookers-on direct towards the quarter from which the procession comes, and their unaccountable indifference to what has already passed; and secondly, the wonderful disappearance, the more or less sudden vanishing out of the very hands of the carriers, of a large majority of the facts and theories of which they make so pompous an exposure; few of them, however, seeming to be aware that thereby they have lost their right to participate in the pageant, and should retire from it into the throng of spectators, at least until good fortune should take pity on them, and drop some new trifle at their feet to soothe their wounded vanity.

You will not suspect me of depreciating the value of any real discovery, be it merely the finding of a Californian bird on the shore of Massachusetts Bay, or detecting, with the naked eye, the blazing of a

variable star before any telescope had noticed it, or finding some Hadrosaurus bones in a New Jersey marl pit, or a Paradoxides at the Quincy quarries? Such accidents have all the importance of trumpet-notes sounding to boots and saddle. But, after all, the trumpeter is only a trumpeter, although he may imagine himself the colonel of the regiment, or a general in the army. And, indeed, it has happened that to such accidents science has owed some of her best physicists and naturalists. But it was not these, their first and therefore most enjoyable discoveries, that made them what they afterwards became; nor had they at the outset even the right to an opinion on the value of their finds. Years of strenuous and unrenowned exertion had to follow, in which they published little or nothing new, but gathered up the old, and rediscovered, by experiment and observation, what the records of the past preserved.

What I deprecate is the claim to special attention made by inexperienced stumblers on forgotten or unnoticed facts, remarkable or otherwise, on the sole ground of the discovery. I deprecate the folly of the youth who, because he has found a spear, leaps into the empty chariot of Achilles, and, calling on the Grecian host to follow him, lashes the horses for an immediate attack on Troy; nor finds it out until he is half way across the plain, that he rides alone, and to destruction. I feel no admiration, no respect, for the audacity with which our young recruits of science rush unpanoplied into the thick of a discussion involving the greatest thinking of the age. They act like animals at a conflagration. I hear on all sides a noisy tumult of untrained intellects. Shall such themes as the nebular hypothesis, the probable solidity or fluidity of our planet, the metamorphosis of rocks, the origin of serpentine or petroleum, the cause of foliation, the stable or unstable geographical relationships of continent to ocean, the probable rate of geological time, the conditions of climate in the ages of maximum ice, the probable centres of life-dispersion, the unity or multiplicity of the human race, the evolution of species, be babbled over by men, the amount of whose efficient work in any branch of science is measurable with a foot-rule; while those whose entire lives have been but one exhausting struggle with the shapes which people the darkness of science speak with bated breath and downcast eyes of these great mysteries?

There is a shibboleth by which tyros in science can always be detected,—their habitual employment of the words ‘doubtless,’ ‘certainly,’ and ‘demonstrated.’ To their inexperience of the universality of error, every new statement in print over a name noted in science, reads like a revelation of the absolute; and every conclusion at which they themselves arrive, after a more or less superficial study of the limited number of facts which accident has given them the opportunity to observe, seems a conclusion too real to be impugned. I love the remembrance of my youth, but I regret its dogmatic impertinences. Young votaries of science draw their inspiration from the maxim which best suits them,—‘try the value of old truths by new discoveries.’ The veterans of

science reverse the rule, and test all new discoveries by a world of half-forgotten facts and well-established principles. The advancement of science is accomplished by the push and pull of these two ruling motives. No science were possible if the aged could suppress the youthful, or the youthful could extirpate the aged. But as surely as the agnosticism of age is a witness to the weariness of fruitless speculation, so surely the confidence of youth that every movement must of necessity be forward is a proof of insufficiency.

Let the military art instruct us. The raw recruit is satisfied if old Blücher waves his sword shouting *Vorwärts!* But the sobered veteran is prepared to see in flank movements, in retreats, in halts and intrenchments, steps of the campaign as necessary as any charge at double-quick on hostile lines, or a steady march in column into the enemy's country. Let us suppose that in the last twelvemonth not one surprising discovery in any region of the globe has been made; that a hundred previously reported facts have been examined and pronounced untrue; a hundred printed memoirs, widely read and criticised, been proved mistaken or absurd; a hundred long-accepted generic or specific names, fossil or recent, have been expunged from the lists; and that others, like *Halysites catenulata*, or *Spirifer disjuncta*, have lost their characteristic values; suppose any amount of doubt to have been thrown upon any number of popularly accepted theories, by failures in applying them to practise, like the theory of the anticlinal location of gas-wells; in a word, suppose any amount of smashing in any department of the great crockery-shop of transcendental or applied science,—what does it imply but the tendency of all inquiry, observation, investigation, and experiment towards the betterment, which is the only true advancement, of science? As in the animal kingdom, the peaceful kinds are offset and held in check by analogous carnivores, for fear of over-population; so in the world of thought, the constructive theorists are perpetually preyed upon by a corresponding class of natural enemies, the destructive critics, which keeps the field open and the air sweet. The destruction of effete knowledge is the perennial birth of that science which cannot be destroyed. But, in recognizing the fact, we should remember that there is a science of items and a science of fundamentals, which bear a relation to each other, like that which subsists between the individuals of a species and species *per se*; and that an indefinite multiplication of individuals may go on without any visible modification of their specific character. The population of Europe has grown in the last century from a hundred and fifty to three hundred and twenty millions of souls; but they are the same Teutons, Celts, and Slaves as ever. On the other hand, the curve of population for France is almost a horizontal straight line; but their national advancement has been phenomenal. What I wish to illustrate is this evident truth, that not by the mere increment of number of facts learned, not by the mere multiplication of discoverers, teachers and students of those facts, but by the elevation of our aims, by the enlargement of our views, by the refinement

of our methods, by the ennoblement of our personalities, and by these alone, can we rightly discover whether or not our association is fulfilling its destiny by advancing science in America. If, unhappily, our meetings should rather tend to cultivate a love for *bric-à-brac* in science, if the stimulation and gratification of a quasi-animal curiosity for scientific novelties be fostered, if our discussions should become hot-beds of a more vigorous vegetation of personal vanity, intellectual pugnacity, lust for notoriety, literary jealousies, conceited reclamations, petty ambitions, or pecuniary schemes, how is our day and generation to be benefited or improved? If our attention become restricted to the details of the creation, and to the smaller manœuvres of the forces of nature; or if, on the other hand, we become habituated in the indulgence of vague generalizations, suggestions of possible theories, and half-completed or merely sketched and outlined hypotheses, — how are we ourselves, as workers of science, to escape deterioration?

I cannot shake off a suspicion that we talk and write too much; that the whole world talks too much; and that the golden time for silence is precisely then when we come together to talk. Were each of us to utter only what he absolutely knows, what he is quite sure of, what he has unimpeachable facts in sufficient number to confirm, — what a sudden illumination would overspread our meetings, glorifying our science, and re-inspiring us all! But I turn from the Utopian fancy, and invite your attention to a very different theme.

There is a topic which I think should be frequently considered by all who engage in scientific pursuits; and by none so earnestly as by those who are ambitious to reach the higher points of view, from which to survey and describe those systematic combinations of phenomena which are more or less panoramic: I allude of course to generalizers or discoverers of natural laws, and the professional teachers of such laws; while those who deal in itemized science, the mere observers of isolated facts, discriminating specimens and naming genera and species in the animal, vegetable or mineral worlds, and especially such as occupy themselves with geographical and geological studies in detail, stand in less need of having it pressed upon their attention, because in their case it insists upon its own necessity.

I allude to what is technically known among experts as 'dead-work.'

This topic has to be treated in the most prosaic style. To describe dead-work is to narrate all those portions of our work which consume the most time, give the most trouble, require the greatest patience and endurance, and seem to produce the most insignificant results. It comprises the collection, collation, comparison and adjustment, the elimination, correction and re-selection, the calculation and representation — in a word, the entire first, second, and third handling of our data in any branch of human learning, — wholly perfunctory, preparatory, and mechanical, wholly tentative, experimental, and defensive, — without which it is dangerous to

proceed a single stage into reasoning on the unknown, and futile to imagine that we can advance in science ourselves, or assist in its advancement in the world. It is that tedious, costly, and fatiguing process of laying a good foundation which no eye is ever to see, for a house to be built thereon for safety and enjoyment, for public uses or for monumental beauty. It is the labor of a week to be paid for on Saturday night. It is the slow recruiting, arming, drilling, victualling, and transporting of an entire army to secure victory in one short battle. It is the burden of dead weight which every great discoverer has had to carry for years and years, unknown to the world at large, before the world was electrified by his appearance as its genius. Let us examine it more closely: it will repay our scrutiny. Those of you who have been more or less successfully at work all your lives may get some satisfaction from the retrospect; and those who have commenced careers should hear what dead-work means, what its uses are, how indispensable it is, how honorable it is, and what stores of health and strength and happiness it reserves for them.

My propositions, then, are these: 1°. That, without a large amount of this dead-work, there can be no discovery of what is rightly called a scientific truth. 2°. That, without a large amount of dead-work on the part of a teacher of science, he will fail in his efforts to impart true science to his scholars. 3°. That, without a large amount of dead-work, no professional expert can properly serve, much less inform and command, his clients or employers. 4°. That nothing but a habitual performance of dead-work can keep the scientific judgment in a safe and sound condition to meet emergencies, or prevent it from falling more or less rapidly into decrepitude; and 5°. That in the case of highly-organized thinkers, disposed or obliged to exercise habitually the creative powers of the imagination, or to exhaust the will-power in frequently recurring decisions of difficult and doubtful questions, dead-work and plenty of it is their only salvation; nay, the most delicious and refreshing recreation; a panacea for disgust, discouragement and care; an elixir vitæ; a fountain of perpetual youth.

In expanding these propositions, I would illustrate them in some such homely ways as should make them seem near and familiar principles of conduct; and of course I can only do this out of the experience of my own life, and from observation of what has happened in the limited sphere of one department of scientific inquiry; but that should suffice, seeing that work is work, and science science, however various may be minds and their pursuits.

First, then, is it so that scientific truths cannot be discovered without a large amount of preliminary dead-work? Surely no one in this assembly doubts it who has established even one original theory for himself, or won for it the suffrages of judges capable of weighing evidence. Now the immense disproportion in numbers between theories broached and theories accepted is the best proof we could have, not only of the value and necessity of dead-work, but of the scarcity of those who depend upon it as a prepara-

tory stage of theorizing. And, moreover, not theories only, but simple statements of fact believed and disbelieved, that is, finally accepted or finally rejected, exhibit the like numerical disproportion, and betray a general carelessness or laziness of observers; at all events, their manifest lack of appreciation of the value and necessity of the dead-work part of observation, which imperatively must precede any clear mental perception of the simplest phenomenon, before the attempt is made to establish its natural relationships, and present it for acceptance as a part of science.

A geologist travels far to collect fossils at a particularly good locality, stops there a day or two, fills his valise, and returns to publish a paper on it. What is his paper worth? Were he first to spend a week in making himself acquainted with the whole vicinity, a second week in making measured sections of all the cognate outcrops in the neighborhood, a third week in carefully differentiating the specific horizons, and a fourth week in verifying their reliability, and in correcting his first mistakes, then, surely, whatever labor he should afterwards expend upon his collection of life-forms would have its full value; and any paper he might write would be an important contribution to his branch of science.

I have known men settle to their own satisfaction some of the greatest problems in geology by a flying reconnaissance; triumphantly overturning a mass of accumulated science slowly brought to demonstration by many years of conscientious dead-work, which they did not seem to think it worth their while to verify. I have known men reclassify the elements of a geological system by a few sections, not a single one of which was properly measured by them, or could be properly put on paper in a graphic form for precise comparison. I have known men make what they called a geological map, without having run a single instrumental line themselves; with every outcrop inaccurately placed; with only here and there an accidental note of strike and dip, and even this not oriented with a close approximation to precision; covering a region requiring the study of many months, with a few weeks of what they fondly called field-work; and basing on such a map generalizations of the first rank, for which they expected the world of science to give them credit; which in the long run it certainly will, but not the kind of credit they anticipate.

Now, the experience of a long and active life of science has trained me to regard all such work as careless work, lazy work. Not that such workers are lazy men in the common meaning of the word; on the contrary, they are busy, bustling, active, energetic, indefatigable men; in fact, too much so. In science, there is a laziness of quite another definition; namely, a chronic dislike, a deep-seated disability, for the dead-work which first disciplines to accuracy, then makes patient and cautious, and finally bestows the clearest intelligence and largest comprehension of phenomena. And this fatal laziness is fostered by a strange misunderstanding, a fancy, sometimes a downright conviction, that the dead-

work of science can be done for us by some one else, so as to save our time and strength for speculation, for thought, for fine writing; can be done by menials, employees, assistants, colleagues, special experts, — by any one rather than by ourselves. Can we not in fact often find it already done for us, and even better done than we could do it? Then, why not let inferior minds occupy themselves with this laborious and time-consuming address of special skill? Can we not, for instance, hire transit-men to lay out and measure our sections, and artists to draw them? Why should a paleontologist take the pencil between his own fingers in studying species, when he has trained photographers and lithographers at his command? Why waste precious weeks and months in tramping and climbing, in measuring and plotting, while glory calls us, and the scientific world is impatiently waiting for our conclusions? Thus possessed by the demon of scientific haste, we continually spoil our own performances, and disappoint the expectant, but not at all impatient world. Could our vanity permit us to know the fact, the impatience is entirely our own, and, if indulged, is sure to be roundly punished.

No; dead-work cannot be delegated. The man who cannot himself survey and map his field, measure and draw his sections properly, and perfectly represent with his own pencil the characteristic variations of his fossil forms, has no just right to call himself an expert geologist. These are the badges of initiation; and the only guaranties which one can offer to the world of science that one is a competent observer, and a trustworthy generalizer. Nor has one become a true man of science until he has already done a vast amount of this dead-work; nor does one continue in his prime, as a man of science, after he has ceased to bring to this test of his own ability to see, to judge, and to theorize, the working and thinking of other men. But enough of this.

My second proposition was, that no teacher of science can be successful who does not himself encounter some of the dead-work of the explorer and discoverer; who does not discipline his own faculties of perception, reflection, and generalization, by field-work and office-work, independently of all text-book assistance; who does not himself make at least some of the diagrams, tables, and pictures for his classroom, in as original a spirit, and with as much precision of detail, as if none such had ever been made before, and these were to remain sole monuments of the genius of investigation. What the true teacher has to do first and foremost, is to wake up in youthful minds this spirit of investigation *ab initio*. The crusade against scholastic cramming promises to be successful; but the crusade against pedagogic cramming has hardly yet been organized. How is the scholar to be made an artist if the teacher cannot draw? The instinct of imitation in man is irresistible. Slovenly drawing on the blackboard — sufficient evidence of the teacher's imperfect information and inaccurate conception of facts, the nature of which he only thinks he understands — can do little more than raise a cold fog of suspicion in the class-room, by which the tender sprouts of learning must be

either dwarfed or killed. But even slovenly diagrams are preferable to purchased ones; for whatever diminishes the dead-work of a teacher, enervates his investigating, and thereby his demonstrating, powers, and lowers him toward the level of his scholars.

Were I dictator, I should drive all teachers of science out into the great field of dead-work; force them to go through all the gymnastics of original research and its description; and not permit them to return to their libraries until their note-books were full of their own measurements and calculations, sketches, maps and form-drawings, severely accurate and logically classified, to be then compared with those recorded in the books. What teachers fail to keep in mind is this: that learning is not knowledge; but as Lessing says: Learning is only our knowledge of the experience of others; knowledge is our own. No man really comprehends what he himself has not created. Therefore we know nothing of the universe until we take it to pieces for inspection, and rebuild it for our understanding. Nor can one man do this for another; each must do it for himself; and all that one can do to help another is to show him how he himself has morsellated and recomposed his small particular share of concrete nature, and inspire him with those vague but hopeful suggestions of ideas which we call learning, but which are not science.

My third proposition was, that an expert in practical science can command the respect and confidence of his professional fellows, and, through their free suffrages, build up his own reputation in the learned and business worlds, only in exact proportion to the amount of good dead-work to which he voluntarily subjects himself. For, although the most of it is necessarily done in secrecy and silence, enough of it leaks out to testify to his honest and diligent self-cultivation; and enough of it must show in the shape of scientific wisdom, to make self-evident the fact that he is neither a tyro nor a charlatan. More than once I have heard the merry jest of the Australasian judge quoted with sinister application to experts in science. When a young colleague, just arrived from England, asked him for advice, he answered: Pronounce your decisions, but beware of stating your reasons for them. Many an ephemeral reputation for science has been begot by this shrewd policy; but the best policy to wear well is honesty; and honesty in trade means selling what is genuine, well-made, and durable; and honesty in science means, first, facts well proved, and then, conclusions slowly and painfully deduced from facts well proved, in sufficient number and order of arrangement to exhaust alike the subject and the observer. Reap your field so thoroughly that gleaners must despair. Fortify your position, that your most experienced rival can find no point of attack. Lay your plans with such a superfluity of patient carefulness that fate itself can invent no serious emergency. Demonstrate your theory so utterly and evidently that it shall require no defender but itself. Die for your work, that your work may live forever. Forget yourself, and your work will make you famous. Enslave yourself to it, and it will plant

your feet upon the necks of kings, and your mere Yes or No will become a law to multitudes. This is what the dead-work of science, when well done, does for the expert in science.

My fourth proposition — that only the habitual performance of dead-work can preserve the scientific intellect in pristine vigor, and prevent it from becoming stiffened with prejudices, inapt to receive fresh truth, and forgetful of knowledge already won — hardly needs discussion. Human muscles become atrophied by disuse. Men's fortunes shrink and evaporate by mere investment. I pray you to imagine what I wish to say; for it all amounts to this — that the grass will surely grow over a deserted foot-path. Let me hurry to the close of this address, which I have found too serious a duty for my liking, and perhaps you also have found it too personal a preachment for yours. One more suggestion, then, and I have done.

My fifth proposition was, that the wearied and exhausted intellect will wisely seek refreshment in dead-work.

The physiology of the brain is now sufficiently well understood to permit physicians to prescribe with some assurance for its many ills, and to regulate its restoration to a normal state of health. Its tissues reproduce themselves throughout life if no extraordinary overbalance of decay takes place, if there be no excessive and too long continued waste. For the majority of mankind, nature provides for the adjustment between consumption and reproduction of brain-matter, by the alternations of day and night, noise and silence, society and solitude; and also by the substitution of the play of fancy in dreams, for the work of the judgment and the will in waking hours. We follow the lead of nature when we seek amusement as a remedy for care. We bring into activity a rested portion of the brain, to permit the wearied parts of it to restore themselves unhindered.

This is the rationale of the pathological treatment of the brain. Tell an over-worked president of a railway company, who falls asleep at the director's meeting, that he must *rest*, or die of softening of the brain, and he will smile a sad reply, that he *cannot rest*. He is right, thus far: he cannot rest his whole brain; but he can rest the cerebellum, — the seat of the will power, — by bringing into higher activity, and more frequent exercise, the upper and frontal lobes. Let him stop thinking of leasing rival lines, and read novels, and play billiards. Let him ride some youthful hobby, revive his practise on the violin, cultivate flowers, keep a stud and kennel, bury himself in Greek and Latin literature, collect pictures, minerals, do any thing which will really interest him, and keep him out of the way of railroad men and railroading; and do it with his might, with enthusiasm, even to fatigue; and do it for at least four years, and by that time his cerebellum will be all right again.

Now what the unintermitting responsibilities of the railroad official do for the destruction of the constitution of his cerebellum, just that the overstrained exercise of the creative imagination does

for the demoralization of the brain of the man of science, especially if it be, as it commonly is, accompanied by business anxiety. And his only way of escape from a predestined break-down is through the monotonous, but interesting occupation of his perceptive faculties in the field, and at his office table. In both he will enjoy that solitude which resembles sleep, in being a medicine for the weary brain. But it is a solitude peopled with unexceptionable friends; in which care sleeps, and pleasure wakes; a solitude in which the soul multiplies itself by alliance with all the possibilities of number, and all the actualities of form; a solitude from which a man returns to the society of his fellow-men, sainted by the blessing of nature, and equal to the duty of existence.

In conclusion, I must express the wish that this meeting of our association may be as delightful and as useful as any that it has ever held. Those who remember how hard we used to work at them, what a harvest of mutual confidences we used to gather at them, and what a glow of fresh enthusiasm we carried away with us from them, will know what such a wish implies. Those who come fresh to this meeting will find themselves made at home in half a dozen worlds of science at once. That is the particular character and special charm of this association, wherein it differs from all local societies, and from all conventions of workers in special branches of science and art. And, as each meeting furnishes a panoramic view of the present state of human knowledge as a whole, so, at each meeting, the old and the young in science are mingled in such friendly and confidential intercourse, that the prospect extends both backwards to the beginnings of inquiry, and forwards to its possible achievements. All good tradition is precious; and so is well-trained current inquiry, and so is sound prophetic calculation. At such a meeting as this, we enjoy the rare privilege of assisting at all three; and, when we scatter to our homes, we can hardly fail to take with us something effectual for lightening and sweetening another year of work.

STANLEY'S KONGO.

Four hundred years ago, a Portuguese navigator, sailing along the western shores of Africa, discovered the mouth of a mighty river, which, for many years, was known as the Rio Padrão, or Pillar River, flowing through the kingdom of Kongo. In 1578, however, Lopez described it as the Zaire — a corruption of the native word for river. The Portuguese still call it the Zaire; but English map-makers, since the early part of the seventeenth century, have used the word Kongo as a designation of either the whole or a part of its lower course. There is no good reason for this: but, of all things, geographical names are the

least susceptible to reason; and Kongo seems destined to drive out all other appellations, and to spread over the whole course of the river and surrounding country.

The early voyagers confined their explorations to the mouth of the river; and the first attempt, of which we have reliable information, to penetrate inland along its banks, was made by an Englishman, Capt. Tuckey, in 1816. Thirty white men started on this ill-fated expedition: eighteen died almost immediately; and the remainder returned to England, after having been on the river three months, and having explored it for the comparatively short distance of one hundred and seventy-two miles, the greater part of which was by water. This terrible loss of life deterred others from penetrating the unknown regions by the Kongo route. In 1867, however, David Livingstone, travelling westwards from Lake Nyassa, found the Chambezi River, which he afterwards traced to Lake Bangweolo, or Bemba. Thence, under the name of Luapula, it flowed into Lake Mweru, and was met with again at Nyangwe as the Lualaba. Thus much Livingstone had discovered before he died on the shores of Lake Bangweolo. His remains were lovingly escorted to the ocean by his negro servants, and were interred in Westminster Abbey with befitting ceremony. Stanley — then known as the correspondent of the *Herald*, who had penetrated to Lake Tanganika in a successful attempt to find Livingstone — was one of the pall-bearers. Not long afterwards, he strolled into the office of the London *Daily telegraph*. While talking with some of the staff, the editor, Edwin Arnold, entered. The conversation turned upon Livingstone and his work. Suddenly Mr. Arnold, who had been fascinated by the explorer's eye, asked him if he could and would complete the task. As a result of this interview, Stanley reached Nyangwe in October, 1876. He followed the Lualaba to the sea, and proved that the Zaire of the Portuguese, the Kongo of Tuckey and the English map-makers, and the Lualaba, Luapula, and Chambezi of Livingstone, were one and the same river. He then returned to Europe, and soon found himself at the head of an expedition to open the heart of the Dark Continent to the trade of the civilized world *via* the Kongo. These two volumes contain the history of that work.

The estimated length of the Kongo¹ — from its mouth in the Atlantic, to its source in the Chibale Hills, a little to the east of the southern end of Lake Tanganika — is 3,034 miles,

The Congo, and the founding of its free state. By HENRY M. STANLEY, with illustrations and maps. 2 vols. New York, Harper, 1885. Pp. 28+528, and 10+483. Illus., maps. 8°.

¹ The total estimated length of the Amazon is 4,000 miles; of the Mississippi, 3,160; and of the Missouri-Mississippi, 4,265. — cf. *Imperial Gazetteer*, 1876.

as follows: From the ocean to Vivi, at the head of navigation from the sea, is 110 miles. Thence to Isangila at the upper end of the lower Livingstone Falls is 50 miles. Between Isangila and Manyanga, 88 miles away, the river is 'tolerably navigable.' From Manyanga to Leopoldville, for 85 miles, it pours over the upper Livingstone Falls. Leopoldville once attained, the river can be navigated for 1,068 miles to the foot of the Stanley Falls. Thence to Nyangwe is 385 miles. From Nyangwe to its source—including the lakes—is 1,248 miles. It must be understood, however, that much of this last section of the river has never been explored, and that therefore it may turn out to be longer.

Stanley's first and most difficult work was to open a road around the Livingstone Falls, and to launch two small steamers in Stanley Pool. His force of a little over a hundred men was singularly inadequate to the task; and a whole year elapsed before the first section of the road—from Vivi to Isangila, a distance of fifty-two miles—was constructed, and three steamers dragged over the hills, and put into the river. So great were the difficulties of this undertaking, that it is almost impossible to applaud too highly the resolution and energy of the chief of the expedition. None the less, however, is it to be regretted, that he was compelled to purchase the co-operation of the natives by gifts of ardent spirits. 'It was the custom,' he says, and could not be resisted. Between Isangila and Manyanga, a ferry was established, one of the steamers being employed on that service. With the other two, he pushed on overland again; and the end of the next year found him established at Leopoldville, above the falls. The road-making was over, and Stanley was at liberty to explore the great river and its tributaries as far as Stanley Falls. He discovered Lake Leopold II., and ascended many streams. It was at the mouth of the Beyerre that he first heard of the presence of the Arab slave-traders, whom he came across some distance farther up-stream. They had with them 2,300 slaves, —the spoil of 118 villages,— 'obtained,' to use his own words, 'at the expense of 33,000 lives.' This is probably an exaggeration. But if the Kongo Free State is to be a success, commercially or otherwise, it is evident that slave-hunting, on such an extensive scale at least, must be stopped. Is the International association strong enough to put an end to it?

Stanley estimates the navigable length of the Kongo basin between Leopoldville and

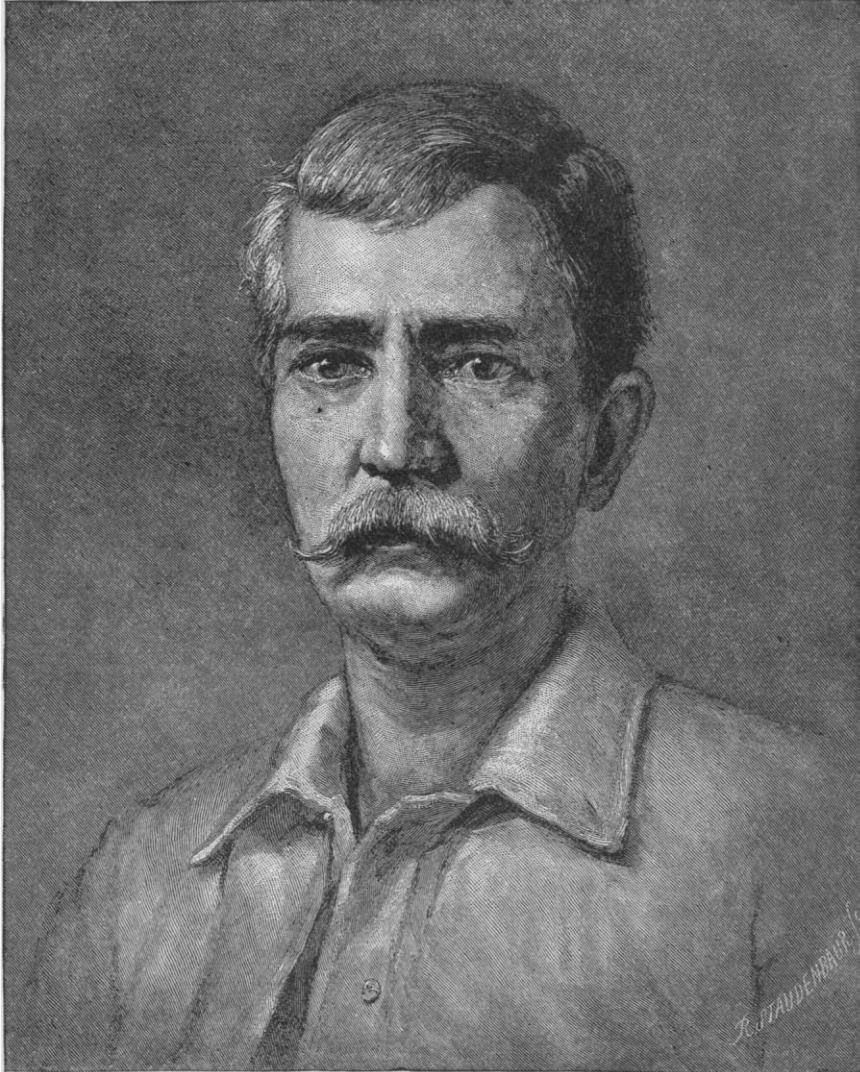
Stanley Falls, including tributaries, at 5,249 miles; but much of this estimate is pure guesswork. As an example of this, take the following: "Sixty miles above the Lukanga, we arrive at the fine river Mohindu. We only explored it for about eighty miles; but, considering its magnitude and the native reports, we may estimate its navigability to be about 650 miles!" Are not native reports and magnitude rather insecure data upon which to found such an estimate, especially when the Lubiranzi and the Chofu are impassable twenty-five miles from their confluences with the Kongo? A similar flavor of exaggeration characterizes the whole chapter on the commercial value of the river.

It is perfectly easy to see that the future growth of the Free State depends upon connecting some station on Stanley Pool—probably Kinshassa, as Leopoldville is very unhealthy—with the portion of the river below open to sea-going vessels. Mr. Stanley, therefore, has endeavored to show that such a road could be built, and operated with profit: "As a mere speculation, there is nothing in the whole world offering so remunerative an investment of capital as this small railway." The cost of construction, he argues, at £4,000 per mile,—surely a low estimate,—would amount to only £940,000, with an assured gross revenue of £300,000 per annum. Supposing his estimate of cost and gross revenue to be correct, what would be the net revenue? How could the road be built? By Europeans? They could not stand the climate. By Africans? Where could they be obtained, and how paid? Then, again, could the government of the Kongo State grant a right of way, or would that have to be purchased of the natives at considerable expense? Could that government protect the line against native aggression? Finally, if profitable, would not a rival line be built by the French to Brazzaville, their station on the northern shore of Stanley Pool?—a station, by the way, which is not to be found on Stanley's map. These questions do not seem to have been considered by our author, as they certainly should have been.

An obstacle to the development of the Kongo State, beside which this transportation problem dwindles into insignificance, is to be found in the climate. Take Stanley himself as an example. Assuredly no one will dispute his experience in African travel, nor his energy and resolution. Yet, after one year on the Kongo banks, he gave himself up for lost, summoned his men about him, and prepared to

die. His recovery, at that time, he attributes to a dose of sixty grains of quinine. Two years later he again broke down, and fled to Europe for safety. His European staff numbered from first to last 253 men. Of these, 23 died from sickness, 4 were killed by accident,

ever, although without recalling one of the hard words he had written of his subordinates, Mr. Stanley confesses that his principal stations, Vivi, Manyanga, and Leopoldville, were located on very unhealthy sites. They were all on high land, and exposed to the cold winds



HENRY M. STANLEY (London *Illustrated News*).

and 92 returned home. They were all in the prime of life. At first this sickness and intense desire to get away from the deadly river is laid by our author to 'whisky;' next, to 'malingering' and 'sojering.' Finally, how-

blowing up-stream from the ocean. Strangely enough, the low-lying stations above Leopoldville seem to have been very healthy. There has been almost no sickness; for instance, at Equator Station, "with a river only five feet

below its foundations, creeks sable as ink surrounding it, and the ground unctuous with black fat alluvium." Not a pleasant place to live in, one would say, but healthy, nevertheless. This is a curious condition of affairs, and deserves to be carefully studied by some disinterested person of scientific attainments. In summing up a fifty-page argument, written to prove that the climate is not so much at fault as the individual, Mr. Stanley practically admits the unhealthiness of the whole region. "One more observation," he says, "will suffice. However well the European may endure the climate by wise self-government, years of constant high temperature, assisted by the monotony and poverty of the diet, cannot be otherwise than enervating and depressing, although life may not be endangered. To preserve perfect health, I advise the trader, missionary, coffee-planter, and agriculturist, who hopes to maintain his full vigor after eighteen months' residence, to seek three months' recreation in northern Europe." What a prospect to hold out to the emigrant! Three months out of every twenty-one to be passed away from his business or farm! Would not the expense of such journeyings eat up the profits of the eighteen months of hard work? And how about wife and children? Are the settlers of Kongo State to be bachelors? or are they to be at home only in those three months passed in northern Europe?

Mr. Stanley has not improved as a writer during the last six years. His volumes are full of descriptions of the river and its banks. But they are not interesting, except for the amount of food for thought they contain. His tone, too, towards his understrappers, is very ungracious, to use no harsher term. The maps are excellent, although it is difficult to see why the eastern half of the large map was not extended to the ocean; and a map on a larger scale of the country around the Livingstone Falls should have been added. With a few exceptions, the illustrations are wretched. They will not bear a moment's comparison with those in H. H. Johnston's 'Congo from its mouth to Bolobo.' Only seventeen out of the hundred and twenty-two are stated to have been made from photographs or sketches. The rest seem to have been drawn on demand, so to speak, in London. The wood-engraving, too, is very poor, the pictures having a hard and flat appearance that is displeasing to the eye; while the flamboyant cover-design of a negress poised on the Belgian coat-of-arms defies description, and must be seen to be appreciated.

NOTES AND NEWS.

—THE Electric power company of New York announce that they have established an electric railway running from Baltimore to Hampden, two and a half miles. The road is very crooked, and the gradients are as high as three hundred and fifty-two feet to the mile. The motor draws a loaded car, carrying sixty-five passengers without difficulty, stopping and starting on the grade without slip of the wheels.

—Mr. Edward Burgess, the designer and builder of the new yacht *Puritan*, is the secretary of the Boston society of natural history.

—The report in the newspapers of the country of a shower of meteoric stones at Salem, Ind., and the injury by them to buildings and several persons, proves to be without any foundation in fact.

—The Macmillans have just issued an 'Elementary algebra for schools,' the joint work of Mr. H. S. Hall, assistant master at Clifton College, and Mr. S. R. Knight, late assistant master at Marlborough College, — a work which is said to differ in some important respects from the text-books now in use. The same publishers also announced a 'Treatise on differential equations,' by Mr. A. R. Forsyth, Fellow of Trinity College, Cambridge, and an 'Arithmetic for schools,' by the Rev. J. B. Lock, whose works on trigonometry have been favorably received.

—The schooner *Rosario*, at New York, reports that on June 23, in lat. $29^{\circ} 14' N.$, long. $133^{\circ} 35' W.$, at 11 A.M., two heavy shocks of a submarine earthquake were experienced. These were about one minute apart; and the last was much heavier than the first, causing the vessel to tremble violently. The sky was overcast, and the sea remarkably smooth.

—Among the French species of the genus *Polygonum*, hybrids are rare in a state of nature; although there are two kinds of flowers, one fertile, the other sterile. In reply to some criticisms upon Gandoger's work on this group, he replies that this fact does not necessarily mark a degradation, but simply a different aptness in fecundation among different flowers; and that, although the absence of fertile grains point toward hybridity, this is not a sure sign.

—As much of recent geographical discovery in Asia has been due, says the *Athenaeum*, to native explorers trained in the surveyor-general of India's department, it will be interesting to place on record a list of the rewards lately granted by the government of India to some of the more prominent of these pioneers of Indian commerce. The most distinguished of them all, A. K., has received the title of Rai Bahadur, and with it a *jaghir* of rent-free land. The explorer known as 'the Bozdar' has been made a Khan Bahadur, and he also has received a grant of land. 'The Meah,' who accompanied Mr. McNair in his journey to Kafiristan, has been rewarded with a sum of money, and the same recompense has been given to A. K.'s companion; while a piece of plate has been presented to Mr. Penny, a planter who afforded the survey-officers much assistance during the Aka operations.